REMARKS

This is a full and timely Response to the non-final Office action of August 22, 2000. For this response, claims 1, 4-11, and 14-18 remain pending in the application. Claims 2, 3, 12, 13, 19 and 20 have been canceled. Claims 1-7 and 9-20 stand rejected by the Examiner under 35 U.S.C. § 102(b). Claims 8 stands rejected by the Examiner under 35 U.S.C. § 103(a). The Applicant respectfully requests reconsideration.

Rejections Under 35 U.S.C. § 102

Claims 1-7 and 9-20 stand rejected by the Examiner under 35 U.S.C. § 102(b) as being participated by Greene et al (U.S. Patent No. 5,579,455). With respect to claims 1, 11 and 18, which are the independent claims in the present application, the Examiner states that Greene et. discloses creating a Z pyramid data structure (col. 5, lines 51 – 52), the z pyramid data structure comprising at least first and second levels, each level comprising a plurality of regions (col. 5, lines 51- 65), each region comprising subregions (col. 26, lines 38 – 39), each subregion corresponding to a single Z value (col. 26, lines 39 – 45), each region corresponding to a plurality of Z values of the region, wherein each subregion in the second level has a Z value that corresponds to a maximum Z value of a plurality of subregions in the first level (col. 26, lines 47 – 51), the logic comparing the minimum Z value of each primitive with the Z value of a region associated with the tested primitive to determine whether or not the tested primitive is fully occluded (col. 26, lines 61 – 67).

The Applicant respectfully disagrees. The Greene et al. patent cited by the Examiner appears to be directed to the same invention that is described in the article by Greene et al. discussed in the "Background of the Invention" in the present application. Both the article and the patent disclose utilizing cubes to perform the Z-pyramid comparison tests and performing the Z comparison tests beginning at the top of the pyramid and moving downwards towards the bottom of the pyramid until a determination is made that a cube is either fully occluded or is determined to be at least partially visible.

In essence, in Greene et al., once the Z pyramid has been constructed, the Z values for the primitives making up the faces of the cubes are compared beginning at the highest level of the pyramid and working down towards the base of the pyramid. For each primitive of a face of a cube, the minimum Z value of the primitive is tested against the levels of the pyramid in

a top-to-bottom sequence. If the minimum Z value for the primitive is greater than the pyramid Z value, then the primitive is fully occluded. If all of the primitives making up all of the faces of the cube are occluded, the cube is occluded and can be discarded. If not, the process continues to the next level of the pyramid. At each level of the pyramid, the process is performed until a determination is made that the cube is either fully occluded or until the process reaches the level in the Z pyramid at which a primitive is found to be at least partially visible.

As stated in the "Background of the Invention" in the present application, the approach described in Greene et al. enables a plurality of primitives to be simultaneously tested instead of individually testing each primitive. However, the approach of Greene et al. does not make any provision for updating the Z pyramid "on the fly", i.e., as primitives are being processed through the graphics pipeline. Once a determination is made that a cube contains a visible primitive, the visible primitive must be scan converted to the pixel level before the Z buffer can be updated and the Z pyramid can be reconstructed. Greene et al. only makes a provision for marking the rendered (i.e., scan converted) primitives to avoid scan converting them more than once. (See Col. 5, lines 30-37). All of the algorithms described in Greene et al. require that each face of each cube be scan converted in order to determine whether or not the cube is hidden. Therefore, the algorithms inherently require that scan conversion be performed before the Z pyramid can be updated.

In contrast, the present invention enables the Z buffer to be updated and the Z pyramid to be reconstructed on the fly as primitives are processed prior to scan conversion. Independent claims 1, 11 and 18 have been amended to more accurately point out this feature of updating the Z pyramid on the fly. In accordance with the present invention, as described in independent claims 1, 11 and 18, each region corresponds to a plurality of Z values and has a maximum region Z value which corresponds to the largest Z value of the region. The minimum Z value of each primitive is compared with the Z value of a region associated with the primitive to determine whether or not the primitive is fully occluded. If a determination is made that the primitive is not fully occluded, then a determination is made as to whether or not any subregion of the region associated with the primitive is fully covered by the primitive.

If a determination is made that a subregion is fully covered by the primitive, then the logic determines whether or not the Z value of the covered subregion needs to be replaced
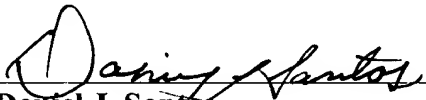
with the maximum Z value of the tested primitive. If so, the Z pyramid is updated accordingly. Thus, the Z pyramid is updated on the fly, rather than waiting until primitives have been scan converted. This, in turn, expedites the Z comparison tests and improves the overall performance of the computer graphics display system.

Since all of the independent claims in the present application include these features of the present invention, the Applicant respectfully requests that the rejection of the independent claims, namely, claims 1, 11 and 18, be withdrawn. Since all of the remaining claims depend either directly or indirectly from one of these dependent claims, the Applicant respectfully requests that the rejections of the independent claims also be withdrawn.

CONCLUSION

In view of all the foregoing, the Applicant respectfully submits that claims 1 – 20 are in condition for allowance and such action by the Examiner is earnestly solicited.

Respectfully submitted,

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